

### **Remarks/Arguments**

This letter is responsive to the Office Action dated November 20, 2006. Reconsideration of this application is respectfully requested.

Claims 1-25 are in the case.

### **Claim Rejections 35 U.S.C. Section 103**

The Examiner has rejected claims 1-5, 7, 15 and 17-21 as being obvious in view of the combined teaching of Freeman et al. (U.S. 6,519,539) and Werth et al. (U.S. 4,931,947). The Examiner also rejects claim 6 as being unpatentable over Freeman et al. in view of Werth et al. and further in view of Dunn et al. (U.S. 6,239,579). In addition, claims 8 and 9 are rejected as being unpatentable over Freeman et al. in view of Werth et al. and further in view of Strader et al. (U.S. 4,916,734). Further, claims 10-13 and 22-25 are also rejected as being unpatentable over Freeman et al. in view of Werth et al., Stader et al. and further in view of Bisher (U.S. 5,416,416).

These rejections are respectfully traversed for the reasons given below. Before outlining this argument in detail, different aspects of embodiments of the present invention and the prior art cited in relation to the independent claims, namely Freeman et al. and Werth et al., are summarized below.

### **Background and Summary**

The present invention relates generally to a system and method for measuring internal resistance of an electrochemical device. More particularly, it relates to a system and method for measuring the internal resistance of individual fuel cells within a fuel cell stack, the fuel cell stack operating under dynamic flow conditions as well as under

varying load conditions, either during testing of the stack or during stand-alone power generation in a real world application.

Claim 1 defines an electrochemical system comprising a measuring device including a plurality of inputs connected across the plurality of cells to generate voltage and current signals indicative of voltage and current characteristics of the plurality of cells, and a current supply/draw means for superimposing modulated current values through the plurality of cells. This current supply/draw means is connected to the plurality of cells in parallel with a load to test the fuel cell stack during actual operation.

Similarly, claim 17 defines a method of controlling at least one system operating condition of a multi-cell electrochemical system including a plurality of cells in which modulated current values are superimposed across the plurality of cells of the electrochemical device, and a diagnostic current is drawn from the plurality of cells to generate voltage and current signals indicative of voltage and current characteristics of the plurality of cells. A load current is also drawn from the plurality of cells in parallel with the diagnostic current drawn. The load current is used to drive a load. The at least one system operating condition is controlled based on the voltage and current characteristics of the plurality of cells.

Freeman et al. disclose a measuring device including a plurality of inputs attached in series with the plurality of individual cells within a fuel cell stack. Freeman et al. describe monitoring the performance of the fuel cell stack with the measuring device. As previously noted by the Examiner, Freeman et al. do not disclose a load powered by the plurality of cells, the load being connected to the plurality of cells in parallel with a current supply/draw means.

Werth et al. disclose a hybrid power system incorporating both the fuel cell stack and batteries, which is used to meet the fluctuating demands of an external load. That is, during operation the batteries provide supplemental power, during periods of high

demand. In the system disclosed by Werth et al., the fuel cell stack is connected in parallel with an additional power source, the batteries, to provide the hybrid system.

### **Interview Summary**

On January 9, 2007, the undersigned, Ian McMillan, had a telephone interview with Examiners Berhanu and Easthom. This interview was initially sought to clarify the objections raised by Examiner Berhanu in the Office Action.

It was not clear to the applicant from the Office Action what elements of Werth et al. were considered by the Examiner to satisfy the current supply/draw means limitation recited by claim 1. During the telephone interview, Examiner Berhanu explained that the element of Werth et al. corresponding to the current supply/draw means could be either of the batteries 12 and 14, together with the wire connecting these batteries to the load in parallel with the fuel cell.

During the remainder of the telephone interview, the undersigned and the Examiners discussed the teachings of Freeman et al. and Werth et al. in relation to the claims; however, no agreement was reached regarding the issues raised in the Office Action.

### **Detailed Reply to Claim Rejections**

In paragraph 2 of the Office Action, the Examiner took the position that it would have been obvious to a person having ordinary skill in the art at the time of the invention to connect a load in parallel with a fuel cell and the measurement apparatus disclosed in Freeman et al., as taught by Werth et al., to arrive at the subject matter claimed in the present application. The Examiner did not specifically identify by reference numeral the element of Werth et al. corresponding to the current supply/draw means recited by claim 1; however, from a telephone interview with the Examiner on January 10, 2007, it

appears that the element referred to is either of the batteries 12 and 14 together with the wires connecting them to the load in parallel with the fuel cell.

**Lack of teaching, suggestion, or motivation to combine the references cited**

It is trite law that the Examiner bears the initial burden of establishing a *prima facie* case of obviousness by providing factual evidence when rejecting a claim. To establish obviousness, the prior art references relied upon must teach all claim limitations. Moreover, if the Examiner is relying upon multiple references, there must exist some motivation or suggestion to combine the references. In particular, the Examiner must show how the references either expressly or impliedly suggest the combination claimed or present a convincing line of reasoning as to why the artisan would have found the claimed invention to be obvious in light of the teachings (see *Re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); *Ex Parte Clapp* 227 USPQ 972 (Bd. Pat. App.)). As previously indicated, the Examiner has acknowledged that Freeman et al. alone cannot be a basis for rejecting the present application as not all claim limitations are taught. Rather, Freeman et al. and Werth et al. in combination are relied upon by the Examiner to provide all limitations claimed in the present application.

The applicant has previously argued that there is no suggestion or motivation to combine the teachings of Werth et al. and Freeman et al. In response to this argument, the Examiner recognized that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found in either the references themselves or in the knowledge generally available to one of ordinary skill in the art. The Examiner takes the position that Werth et al. contain such a suggestion and specifically states:

*"In this case, Werth et al. disclose in Figure 1, and Col. 2, lines 55-63, and Col 3, lines 8-14, 18-20 and 38-41, that the fuel cell can be connected in parallel with a load in order to energize the load with rated power output,*

*and to protect the main power source such as battery from battery rundown and extends battery life."*

From this statement it appears as though the Examiner takes that position that Werth et al. teaches the advantages of connecting the fuel cell in parallel with a load as this protects an additional power source, such as batteries, from rundown. Accordingly, the motivation in Werth et al. for connecting a fuel cell in parallel with a load is to protect the battery while energizing the load with rated power output.

Freeman et al. describe a self-contained portable apparatus 10 for impedance measurement of a fuel cell. The self-contained portable apparatus 10 comprises a load bank 100, and a frequency synthesizer 50 is connected to the load bank 100. The frequency synthesizer 50 produces a periodic A.C. waveform and a DC offset used to remotely control the load bank 100 (column 5, lines 41 to 51). The load bank 100 is provided and controlled to test the operation of a test fuel cell 90. During this testing, the test fuel cell 90 is not being used to meet any other load; the only load being met by the test fuel cell 90 is the load bank 100,

Given that Freeman et al. are concerned with monitoring fuel cell performance, it is difficult to see what motivation exists for adding another energy source to supply the load bank 100. Specifically, how would adding another energy source facilitate the monitoring of fuel cell performance with which Freeman et al. are concerned? Bear in mind that the load bank 100 disclosed by Freeman et al. is programmed to draw a desired large DC current to test fuel cell performance. In other words, the purpose of the load bank disclosed by Freeman et al. is to test fuel cell performance. That being the case, what motivation would there be to add another energy source to help the fuel cell meet load requirements? If anything, this would actually interfere with testing fuel cell performance as the deficiencies in fuel cell performance in meeting transient or high loads might well be masked by the assistance of the batteries.

Further, and as noted by the Examiner the motivation in Werth et al. for connecting the fuel cell in parallel with a load is to supplement and protect an additional energy source, namely the batteries. It is unclear how this motivation applies to the technological context of monitoring fuel cell performance, as found in Freeman et al., where there no additional energy source is provided. The applicant respectfully submits that the Examiner has failed to show how the motivation of Werth et al. for connecting the fuel cell in parallel (i.e. in order to supplement and protect an additional power supply) expressly or impliedly suggests modifying Freeman et al., which is concerned with monitoring the performance of a fuel cell stack and has no additional energy source supplying the connected load.

To establish a *prima facie* case of obviousness the Examiner is obliged to provide a rationale, articulation or reasoned basis to explain why the conclusion of obviousness is correct (see *Re Kahn* 441 F.3d 977 (2006 U.S. App. F.C.)). Any finding must be based on objective evidence of record and the Examiner cannot rely on conclusory statements when dealing with particular combinations of prior art (see *Re Lee* 277 F.3d 1338 (2002 U.S. App. F.C.)). The applicant respectfully submits that the Examiner has not provided a reasoned basis for connecting the fuel cell and measurement apparatus disclosed by Freeman et al. in parallel with a load as taught by Werth et al.. As previously stated, the Examiner appears to be suggesting that the motivation for connecting the fuel cell in parallel in Werth et al. is to supplement and protect an additional power supply. The Examiner has not provided any reasoned basis as to how this motivation applies in the context of monitoring a fuel cell, when no additional power supply is connected in parallel with the load. When there is no explanation of the motivation or suggestion, one can infer that hindsight was incorrectly used to conclude that the invention was obvious (see *Re Kahn*). It should be emphasized that the Examiner cannot merely rely on hindsight to pick and choose features among isolated disclosures in the cited prior art using the present application claims as a guide (see *Re Fine*; *Ex Parte Clapp*). Most inventions arise from a

combination of old elements and mere identification of each element is insufficient to defeat an application (see *Re Kahn*).

Accordingly, if the Examiner elects to maintain his position that there is some motivation to combine the teachings of Werth et al. and Freeman et al. then clarification is requested. In particular, the Examiner is respectfully requested to clarify the alleged motivation for combining the teachings of these references.

**Combining the teachings of Freeman et al. and Werth et al. does not provide the claimed subject matter**

To establish obviousness, the prior art references relied upon must teach all claim limitations. That is, the Examiner must not only show that there is some motivation or suggestion to combine the references, he must also show that the references when combined teach all of the claim elements. It is respectfully submitted that even if the Examiner had succeeded in showing that there was some motivation to combine the prior art references, the finding of obviousness would still fail as combining the prior art references would not provide all of the claim limitations.

At the top of page 3 of the Office Action, the Examiner notes that "Freeman et al. do not disclose explicitly, a load powered the plurality of cells and the load is connected to the plurality of cells in parallel with the current supply/ draw means." As mentioned above, the Examiner takes the position that this missing element of Freeman et al. is supplied by Werth et al.

For the sake of argument, say that the teachings of Freeman et al. and Werth et al. are combined, despite there being no apparent motivation for doing so. Then, presumably the teachings of Freeman et al., as modified by the teachings of Werth et al., would teach a battery connected to the load bank 100 in parallel with the fuel cell 90 such that both the fuel cell 90 and the battery power the load bank 100. In other words,

one current  $i_1$  would flow from the battery to the load bank, while another current  $i_2$ , would flow from the test fuel cell to the load bank, such that  $i_1$  plus  $i_2$  would flow to the load bank 100 in total. In this situation, it is not apparent to the applicant that the battery would supply any current to the fuel cell 90.

Claim 1 recites a current supply/draw means for superimposing modulated current values through the plurality of cells. It is not clear to the applicant how a battery connected to the load bank 100 of Freeman et al. to assist the fuel cell 90 in meeting the demand of the load bank 100 would superimpose modulated current values through the plurality of cells. Specifically, there is no indication that the batteries disclosed by Werth et al. comprise modulators for providing a modulated current. It is not apparent what motivation for doing so would exist as the batteries are provided by Werth et al. to meet the demands of the load, which purpose would not be served by modulating the current provided.

Turning to claim 17, this claim covers a method of controlling at least one system operating condition of a multi-cell electrochemical system. This method comprises, *inter alia*, drawing a diagnostic current from a plurality of cells to generate voltage and current signals indicative of voltage and current characteristics of a plurality of cells; and, driving a load using a load current drawn from the plurality of cells in parallel with the diagnostic current. It is not clear to the applicant how these two steps would be implemented even if the teaching of Werth et al. and Freeman et al. were combined. Specifically, only one current is drawn from the fuel cell 90 disclosed by Freeman et al., albeit this single current comprises both direct and alternating components. The single current is drawn by the load bank 100. If the battery disclosed by Werth et al. is connected to this load bank 100 in parallel with the fuel cell 90, then the battery will also provide a current to the load cell; however, it is not apparent to the applicant how adding the battery in this manner would result in two currents – the load current and the diagnostic current – being drawn from the plurality of cells in parallel.



Based on the foregoing, it is respectfully submitted that even if the teachings of Freeman et al. and Werth et al. are combined, despite the lack of motivation for doing so, the limitations of independent claims 1 and 17 would not be satisfied. If the Examiner elects to maintain his position that the combined teachings of Werth et al. and Freeman et al. provide all of the claim limitations of claims 1 and 17, then clarification is requested. Specifically, the Examiner is respectfully requested to identify the specific features of the two references cited that correspond to each of the claim limitations.

### **Dependent claims**

In the Office Action, the Examiner rejected many dependent claims as being obvious in view of the combined teachings of Freeman et al. and Werth et al. For example, claim 2 of the present application specifies that the current supply/ draw means comprises a modulator. In rejecting claim 2, the Examiner takes the position that Freeman et al. discloses a current supply/ draw means comprising a modulator. Further, in rejecting the limitations of claims 3, 4 and 7, the Examiner again referred to the teachings of Freeman et al. However, as admitted by the Examiner at the top of page 3 of the Office Action, Freeman et al. does not disclose that the load is connected to the plurality of cells in parallel with the current supply/ draw means. That is why the Examiner referred to Werth et al.: to provide the current supply/ draw means that was not disclosed in Freeman et al.

Referring to the teachings of Werth et al., it is not apparent to the applicant that the features specified by claims 2, 3, 4 and 7, for example, are features of the battery taught by Werth et al. For example, with respect to claim 2, it is not apparent to the applicant that the battery disclosed by Werth et al. comprises a modulator. Nor, with respect to claim 7, is it apparent to the applicant why this modulator, whether or not it exists, would be arranged to superimpose the modulated current values in burst time periods for high frequency resistance measurement. Recall that the battery of Werth et al. was provided to help to meet the demands of the load. This purpose would not be

served by including a modulator, and would be obviated by providing the current from the battery only during burst time periods.

Accordingly, to provide the limitations of the dependent claims, it is respectfully submitted that the Examiner must identify some motivation for modifying the batteries described by Werth et al. based on the teachings of Freeman et al. to include the claim features. If the Examiner elects to maintain his rejection of the dependent claims based on the combined teachings of Freeman et al. and Werth et al., then clarification is requested.

It is further respectfully submitted that that for the same reasons, the remaining claims, which ultimately depend from either claim 1 or claim 17, clear the cited art.

In view of the foregoing, it is respectfully submitted that the claims of the present application are allowable over the cited references. Allowance of the application is respectfully requested. If, the Examiner nonetheless to maintain the rejections made in the final Office Action, then clarification of the grounds on which these rejections are made is requested to more clearly define the issues requiring resolution. If there are any questions regarding the response, the Examiner is respectfully requested to contact Ian C. McMillan at the number indicated below.

Respectfully submitted,

Ravi B. Gopal



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